GE

Grid Solutions

MiCOM Agile P44

5th Generation Subcycle Distance Protection

The MiCOM Agile P44 provides unparalleled protection of overhead lines and underground cables, accommodating any method of system earthing, and extending to cover the most onerous applications with up to nine distance zones. One device reaches from distribution and sub-transmission up to the highest transmission voltage applications.

Multiple main protection elements reside inside each relay: distance, delta directional comparison protection and directional earth fault unit protection (DEF) for solidly earthed systems and a novel transient earth fault detection (TEFD) for isolated or compensated earthed systems. This flexibility permits standardised ordering, simplified application and reduces spares holdings.

One-box bay control capabilities for up to two circuit breakers and up to eight other controllable switchgear items are presented using a full colour graphical HMI screen.

Key Features

- Up to nine distance zones with high speed operation in less than one cycle
- Serial and Ethernet concurrent protocols, switchable by settings
- Advanced IEC 61850 Edition 2 implementation with device settings via SCL files
- CyberSentry™ Advanced Security including AAA, Radius, RBAC, and Syslog
- Settingless power swing blocking – eases configuration and ensures response even as system inertia changes as more renewables are connected to the grid
- With fast start up time of less than 10s, resulting in protection, control and communications without the need to wait

Applications

- Breaker and a half, or mesh feeding with two sets of CT inputs per end, with settable independent CT ratios
- Up to nine distance zones with high speed operation in less than one cycle
- Load blinder prevents spurious trips cascading through the network in extreme conditions such as on the verge of a blackout
- Common or per phase teleprotection signalling, with direct or multiplexed relay-relay communication via optional InterMiCOM^{64} interface on board

Protection & Control

- Subcycle distance protection
- Improved system stability by CB failure fast reset element (< 0.75 cycle)

Advanced Communications

- Redundant communications with zero downtime using optional PRP/HSR protocols
- Latest communication protocol implementation with IEEE 1588 precision-time (PTP)

Cybersecurity

- Designed with an IEC 62443-4-1: 2018 certified Secure Development Lifecycle Process
- Provides the necessary capabilities to build an IEC 62443-3-3: 2013 compliant solution

One-Box Concept

- Integrated full colour display, for single-line diagram control of the protected bay
- Open, close, local/remote and direct function key access facilitate the control of connected switchgear – two circuit breakers plus eight other controllable plant items
- Select-before-operate, breaker health checks and interlocking capabilities

Applications

The configuration column of the menu is used to control which functions the user requires in the intended application, and which may be disabled. Disabled functions are completely removed from the menu, to reduce configuration effort. Intelligent dependencies between settings further supervise visibility, serving to declutter and accelerate the configuration experience.

Workable default settings and a simple-set wizard for the distance zones reduce touch time, training needs, and the risk of error when applying a relay.

Functional Overview

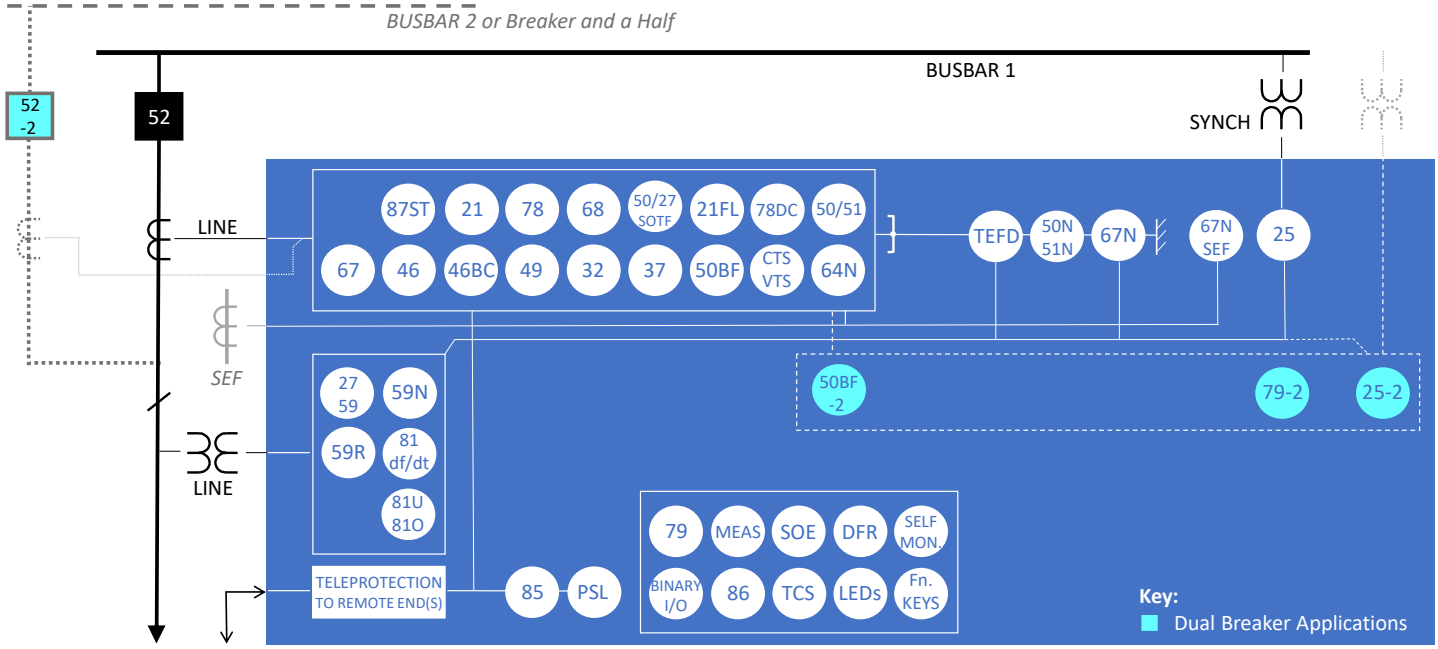


Figure 1: System overview example – shown for a dual breaker application

ANSI® Device Numbers & Functions

DEVICE NUMBER	FUNCTION
25	Check Synchronising
27	Phase and Line Undervoltage
37	Undercurrent
46	Negative Sequence Overcurrent
49	Thermal Overload
50	Phase Definite Time Overcurrent
51	Phase Inverse-Time Overcurrent
52	Circuit Breaker Control
59	Phase and Line Overvoltage
67	Directional Phase Overcurrent
68	Power Swing Blocking
78	Out-of-Step Tripping
78DC	Delta (Incremental) Protection
79	Autoreclose/Adaptive Autoreclose

DEVICE NUMBER	FUNCTION
85	Teleprotection Channel Schemes
86	Latching/Lockout Contacts
21BL	Load Encroachment/Blinder
21FL	Fault Locator
21G	Ground Distance
21P	Phase Distance
46BC	Broken Conductor
50/27	Switch-on to Fault
50BF	CB Failure
50N	Earth Fault Definite Time Overcurrent
50ST	Stub Bus Protection
51N	Neutral/Ground IDMT Overcurrent
59N	Neutral Voltage Displacement
59R	Remote End Overvoltage

DEVICE NUMBER	FUNCTION
64N	Restricted Earth Fault
67N	Directional Neutral/Ground Overcurrent
81df/dt	Rate of Change of Frequency
81O	Overfrequency
81U	Underfrequency
CTS	CT Supervision
PSL	Programmable Logic
SEF	Sensitive Earth Fault
TEFD	Transient Earth Fault Detection
TCS	Trip Circuit Supervision
VTS	VT Supervision

System Application Examples

Breaker and a Half, Double Bus or Ring/Mesh Feeding

The P446 order code offers two sets of CT inputs. The two CTs may have different ratios, which are independently settable in the relay.

CT knee-point voltage mismatch can be tolerated, and, importantly, in the event of breaker failure, the relays will identify the individual failed breaker. If the line is disconnected (line isolator open), the relay provides protection for the stub bus zone.

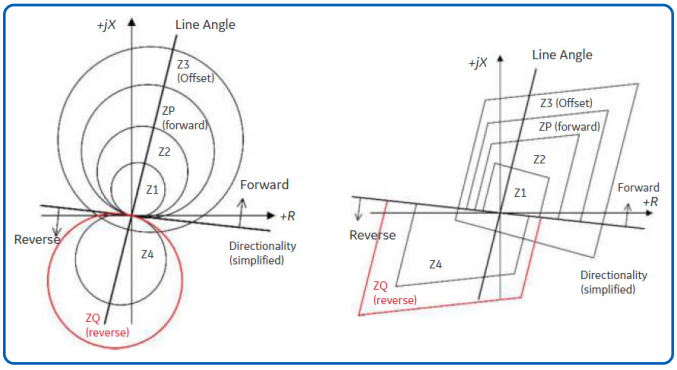
Distance Protection

Nine zones of protection are provided, with a subcycle order option available. A superimposed current phase selector detects the faulted phase(s) and controls which distance elements will initiate a trip. Combined with the directional decision from a proven delta principle, secure operation of distance zones is assured. The relay allows mho and quadrilateral (polygon) characteristics to be independently selected for the phase and ground distance.

Quadrilateral characteristics provide enhanced fault arc resistance coverage. An adaptive technique is used to tilt the reactance reach line of each zone and eliminate under/overreaching effects due to prefault load.

For simplicity, six zones are shown in Figures 2. Additional zones ZR, ZS and Z1e are available.

The distance protection includes CVT (capacitor voltage transformer) filtering for optimum performance with CVTs. This adaptive filtering retains subcycle operation up to a source : line impedance ratio (SIR) of 30, as may apply for weaker renewable in feeds.



Figures 2: Mho and Quadrilateral zones

Blinder characteristics (see Figure 3) prevent false tripping due to encroachment of heavy loads. The load blinder action is selectively inhibited per phase if the phase voltage drops, indicating the inception of a fault. This ensures that the blinder serves to avoid trips on load, but it does not desensitise distance zone response to genuine resistive faults.

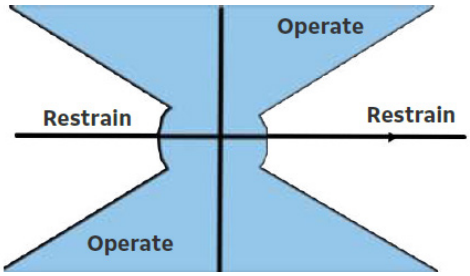


Figure 3: Load blinder

Settings-Free Power Swing Blocking (PSB)

The MiCOM P44 recognises power swings quickly, by means of the superimposed currents measured by the phase selector. This approach is automatic and settings-free, with no impedance bands nor timers to set. The user does not need to anticipate the speed (Hz) spectrum of power swings which may develop on the grid – no need to conduct expensive modelling studies.

A conventional PSB element based on an impedance band is also provided for users with a more traditional preference.

The distance trip time for faults occurring during a power swing remains subcycle.

Out-of-Step Tripping (OST)

If severe disturbances cause asynchronism risks in transmission networks, it may be necessary to separate into islands using the OST feature. Predictive mode OST initiates separation before damage occurs, just as the acceleration is building and before the current gets high.

As the out-of-step will be experienced right along a transmission corridor, it is desirable to split the system at just one point, close to the electrical centre of the pole-slip. As several distance zones are available in the relay, two which are not used for regular tripping can be assigned for this purpose.

Distance Schemes

Pre-configured distance schemes allow single and three-phase tripping, with or without a signalling channel.

A settable alternative distance scheme mode initiates all the zone timers simultaneously and guarantees faster tripping of time-delayed zones for evolving faults, mimicking the operation of and time-grading with legacy relays deployed in the grid.

Trip on close logic allows accelerated tripping to be selected following manual or auto-reclose. Standard distance and DEF schemes may be assigned to traditional hardwired I/O, or routed using the onboard InterMiCOM^{64} teleprotection.

Direct transfer tripping, permissive underreach (PUTT), permissive overreach (POTT) and blocking schemes are supported, including DACH special schemes (Germanic), open breaker, weak infeed echo and weak infeed trip features. The logic adapts to 2 or 3-terminal distance scheme applications, with phase-segregated teleprotection possible thanks to the large number of InterMiCOM^{64} end-end signalling bits available.

InterMiCOM^{64} Teleprotection

InterMiCOM^{64} allows high performance permissive and blocking type protection to be configured, plus the transfer of any digital status information between two or three line ends. Intertripping is supported too, with channel health monitoring and cyclic redundancy checks (CRC) on the received data for maximum message security.

InterMiCOM^{64} provides 24 end-to-end signals, assignable to any function within the P44 relay's programmable logic. Default fail-safe states can be set in case of channel outage.

Phase Preference for Petersen Coil Earthed and Isolated systems

MiCOM P44 is equipped with phase preference tripping logic for Petersen coil earthed and isolated systems. Tripping for a cross-country fault, can be set to follow either a "cyclic" or an "acyclic" logic order, so that only one feeder is tripped, not disrupting the supply to both feeders experiencing single phase to earth faults.

Delta Directional Comparison – Incremental Protection

Superimposed voltage and current signals are used to make highly secure fault directional decisions. The respective forward/reverse decisions at each line end can be used in a teleprotection scheme for full line unit protection, as proven in the LFDC product.

Transient Earth Fault Detection

MiCOM P44 incorporates novel transient earth fault detection (TEFD) for Petersen coil earthed and isolated systems, implemented as a software function block, with no need to add unreliable analogue hardware, nor analogue processing boards. This approach achieves the most cost-effective functional integration and protection scheme engineering.

Directional Earth Fault (DEF)

The DEF element can be used within the aided schemes to detect high resistance ground faults. The innovative "Virtual Current Polarising" feature ensures correct operation in solidly earthed systems, even when a fault generates negligible zero or negative sequence voltage. Traditional relays would have required an extra CT input to cover this scenario.

Typical Protection Trip Times*

Distance protection trip times for any point-on-wave, including the closure time of a conventional trip relay contact:

- 13 to 19 ms (50 Hz system – subcycle option)
- 12 to 17 ms (60 Hz system – subcycle option)
- 20 to 27 ms (50 Hz system – three-pole tripping model)
- 18 to 25 ms (60 Hz system – three-pole tripping model)

** All trip times are 5 ms faster than shown when using optional high-speed/high-break contacts (HSHB).*

Backup Protection

Phase and Earth Overcurrent

Four stages of both phase and earth fault protection are provided, each selectable as non-directional or directional (forward/reverse). In addition to definite time and predefined IDMT curve selection (see Figure 4), the P44 supports user programmable curves for customised operation and resetting. The profile can be chosen to optimise the protection, without constraining loadability. If a standard curve is not suitable for the application, the user can program and upload a custom variant.

Negative sequence overcurrent and sensitive earth fault (SEF) with 0.5% x In sensitivity are also provided.

Voltage Protection

Under/overvoltage protection may be configured to operate from either phase-phase or phase-neutral quantities. Four independent stages are provided, with a mix of definite time and inverse-time characteristics. A compensated overvoltage function protects the line from Ferranti overvoltages by calculating the positive sequence voltage at the remote terminal.

Residual overvoltage protection is available for detecting earth faults in high impedance earthed or isolated systems.

Broken Conductor

The broken conductor protection detects unbalanced conditions caused by broken conductors, or maloperation of a single phase of switchgear. It operates on the ratio of I_2 to I_1.

Thermal Overload

A single time constant characteristic as per IEC 60255-8 is provided to protect cables, dry type transformers and capacitor banks. An additional dual time constant characteristic is suitable to protect in-zone oil-filled transformers, serving to protect the winding insulation from ageing and to minimise gas production by overheated oil.

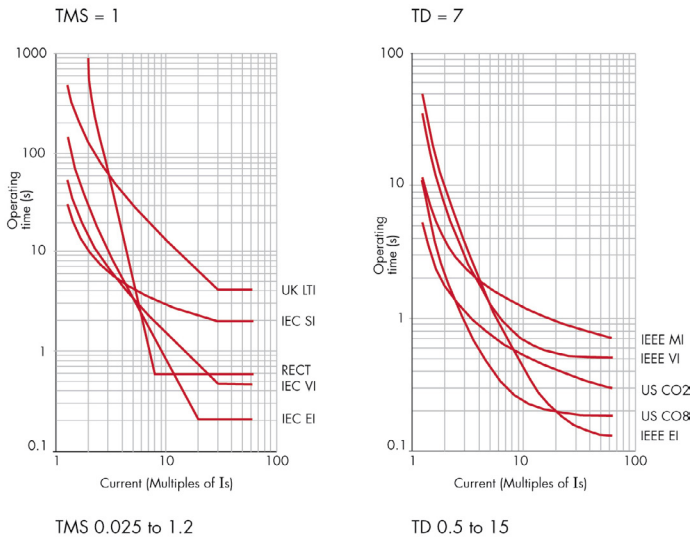


Figure 4: Standard IDMT curve types

Power Protection

Four stages of directional power protection are provided and each stage can be independently configured to operate as overpower or underpower and forward or reverse direction.

Frequency Protection

Nine stages each of: overfrequency, underfrequency, rate of change of frequency, frequency supervised rate of change of frequency, average rate of change of frequency – for frequency-based load shedding during severe system disturbances.

Supervisory Functions

VT Supervision (Fuse Fail)

Voltage transformer supervision is provided to detect loss of one, two or three VT signals for line VTs.

CT inputs – Safety and Supervision

All CT inputs are dual-rated at 1 A and 5 A to simplify ordering and strategic spares inventories. The terminal block features integral shorting to prevent dangerous voltages being present should the block be removed. This affords additional safety to personnel who may be working near live apparatus.

Current transformer supervision is provided to detect loss of phase CT input signals.

Circuit Breaker Failure

Two-stage, phase-segregated circuit-breaker failure protection may be used for tripping upstream circuit-breakers and for re-tripping the local circuit-breaker if required. The undercurrent elements used in the CB fail reset mechanism detect the breaker opening in real-time, even when there are subsidence currents in the CT secondary caused by the remnant flux.

IEC 61850-9-2 LE Process Bus Interface

An optional process bus interface is available, allowing the relay to receive current and voltage sampled data from digital instrument transformers. In other digital substation architectures, the -9-2 data is generated by merging units in the yard which digitise conventional 1 A/5 A and 100/120 V secondaries, for safer and more economical cross-site communications to IEDs via fibre optics.

Grid Solutions' -9-2 LE implementation is designed to be especially resilient and reliable in the presence of "noise", such as latency, jitter or missing/suspect data.

Control

User Interface

Ten function keys in 60 and 80TE case sizes operate in two modes, normal and toggled, with integrated tricolour programmable LEDs. These replace traditional hardwired control scheme switches and annunciation, saving on engineering time and wiring costs. Thirteen further tricolour LEDs are available, freely-configurable, in addition to five fixed-function LEDs

In addition to support of English, French, German, Spanish, Italian, Portuguese and Polish languages, the ability to customise the menu text and alarm descriptions is available. Easily switch between English and an additional language on the local display without uploading new firmware.

A USB front port offers ready access by field personnel's laptop computers.

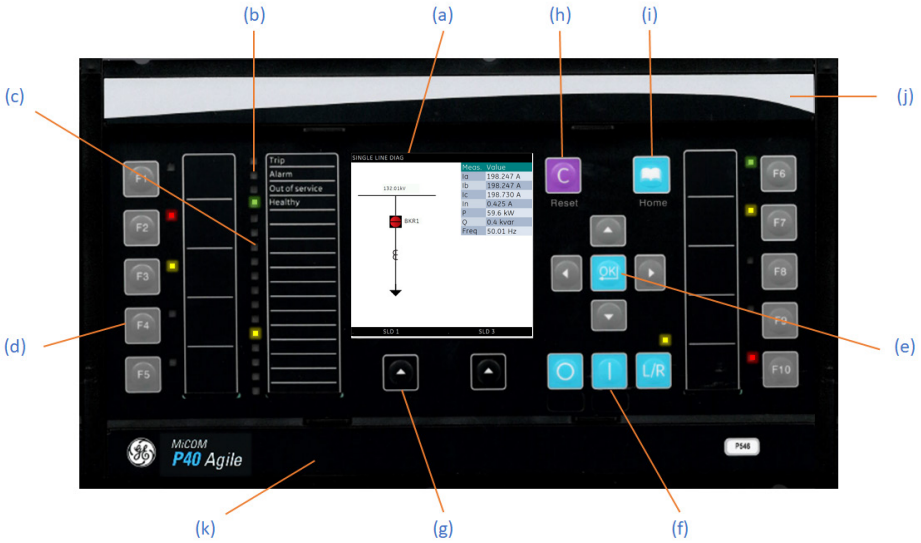


Figure 5: Front fascia view

a. Colour Screen
b. Four Fixed-Function LEDs
c. 13 Tricolour Programmable LEDs
d. Ten Function Keys with Tricolour LEDs
e. Menu Navigation and Data Entry
f. Bay Control and Local/Remote with LED
g. Context-Sensitive Keys
h. Clear Key – Long Press to Reset
i. Read Key – Long Press to Return to Home Screen
j. Top Flap Conceals CORTEC and Rating Labels
k. Bottom Flap Conceals USB(B) Access Port

One-Box Switchgear Control

Circuit-breaker control is available from the front panel user interface, optically isolated inputs and remotely via the substation communications. 8 sets of switch control logic, LN XSWI for controlling/monitoring of disconnectors and earth switches are also available.

Operation of the bay is greatly assisted using the colour graphical HMI, open/close buttons and local/remote control mode switching.

Single Breaker Autoreclose (P443 model)

The user may select a single, two, three or four shot autoreclose cycle. The associated check synchronising feature has predictive close control, to ensure that the CB contacts touch at the instant of synchronism, minimising the stress on plant assets when paralleling.

Dual Breaker Autoreclose (P446 model)

The following additional features are offered in the P446 model to permit two breaker reclosing in a leader/follower scheme:

- Two CB Control - CB1 and CB2 are assigned
- Individual selection of recloser 'on or off'
- Leader-follower configuration
- Independent lockout and reset per breaker

Adaptive Reclosing

The MiCOM P44 has adaptive reclosing, allowing the instant of fault arc extinction to be detected. Reclosing is made possible without having to wait for a regular long, fixed dead time. In so doing, synchronising power is flowing in all three phases quicker, lessening the stability risk to weakly-interconnected systems and/or those with long transmission corridors. Conversely, it allows better identification of persistent faults, allowing a drive to lockout response. Unnecessary operations of switchgear can be prevented, avoiding an extra close and trip shot, thus avoiding additional circuit breaker wear.

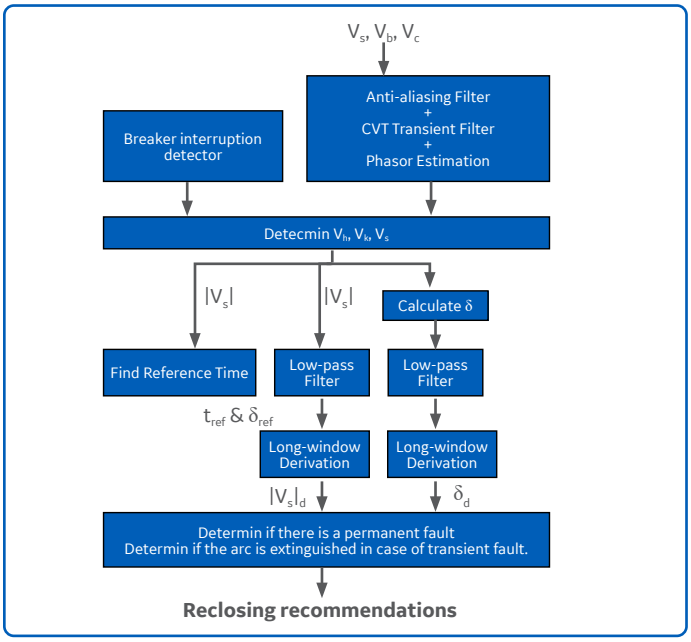


Figure 6: Adaptive reclose logic processing

The algorithm (see Figure 6) uses the rate of change of the faulted phase voltage and angle to distinguish between transient and persistent faults and to detect the time when the arc is extinguished. Typically, the transient fault dead time can adapt to less than 0.25s – half of a traditional fixed dead time – to be ready to reclose as soon as the circuit breaker's trip-free mechanism has reset.

Programmable Scheme Logic (PSL)

Powerful graphical logic allows the user to customise the protection and control functions (see Figure 7). The logic includes 32 timers, 32 counters, 512 gates (OR, AND, MAJORITY) and set/reset latch functions, with the ability to invert the inputs and outputs and provide feedback. Each gate can support a large array of inputs, with a simple right-click of inputs or outputs serving to invert the signal. Output contacts have optional latching (lockout) functionality.

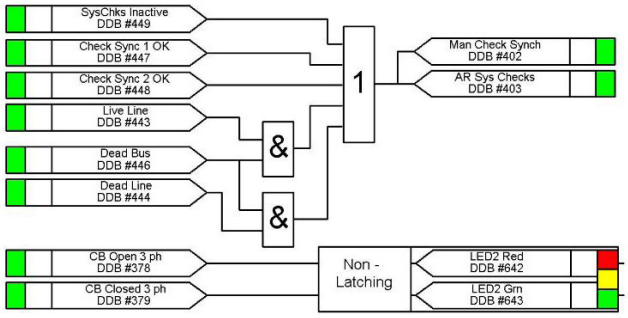


Figure 7: Programmable Scheme Logic

The PSL can be used to implement trip circuit supervision or implement complex logic such as frequency restoration schemes. Schemes are developed capable of supervising the trip coil and circuit with the circuit breaker open or closed, achieving full 'H7' performance.

GE's MiCOM Agile is deterministic – intensive logic and multiple nested gates do not affect the speed of protection tripping, I/O processing, measured or sampled values acquisition nor GOOSE response. The logic gates are processed concurrently, such that logic 'race' scenarios are eliminated.

All aspects of MiCOM P40 IED configuration are managed using the S1 Agile software (see Figure 8). The software is license-free, and able to support .scl top-down engineering, interfacing with .xrio and CAPE simulation environments, and easy Excel import/export where required.

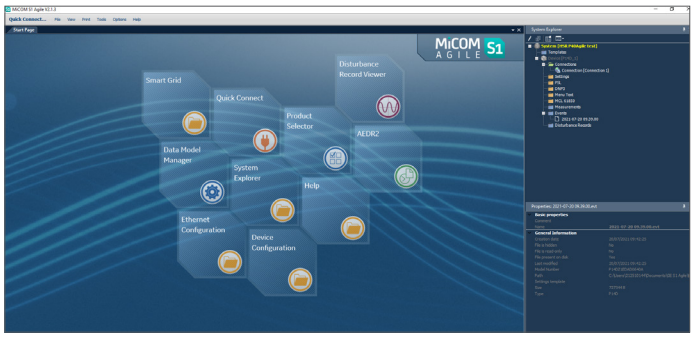


Figure 8: S1 Agile: a powerful and intuitive PC-toolsuite

Binary Inputs and Outputs

Opto-isolated binary inputs comply to the ESI 48-4 EB2 standard and are immune to inductive fields created in substations where wiring runs for hundreds of metres in the yard and neighbouring wires, busbars and power conductors create strong fields. The inputs support programmable pickup with no spurious pickup during battery ground faults or capacitive discharges, thereby making them perfect for plant status monitoring.

Each output relay module provides normally-open (form A) and a generous mix of changeover (form C) contacts. Optional high-speed/ high-break contacts are available, with 30A high break rupturing ensuring no burn-out of contacts during normal operations or situations such as breaker failure or defective CB auxiliary contacts.

Measurement and Recording

All event, fault and disturbance records are time tagged to a resolution of 1 ms. IEEE 1588, NTP or an optional IRIG-B port are available for accurate time synchronisation.

Power System Measurements

Instantaneous and time integrated voltage, current and power measurements are provided. These may be viewed in primary, or secondary values.

Post-Fault Analysis

Fault Location

A fault location algorithm provides distance to fault in miles, kilometres, ohms or percentage of the line length. The innovative algorithm employed tolerates prefault loading and fault arc resistance.

Event Records (SOE)

Up to 5000 time-tagged event records can be stored.

Fault Records

The last 100 fault records are stored as minimum.

Disturbance Records

The oscillography has 16 analogue channels, 128 digitals and 1 time channel, all at a high resolution of 48 samples/ cycle. With 1050s of recording capability, ability to store 100 waveforms of maximum duration of upto 10.5 second duration can be stored.

Circuit-Breaker Condition Monitoring

- Monitors the number of breaker trip operations
- Records the sum of broken current quantity (wear, interruption duty)
- ΣI^x, $1.0 =< x =< 2.0$
- Monitors the breaker operating time

Communications with Remote Operators and Substation Automation

The following protocols are available:

- Courier/K-Bus
- IEC 60870-5-103
- DNP 3.0 (EAI-485 serial)
- IEC 61850 Edition 2 station bus
- IEC 61850-9-2LE process bus
- IEEE 1588 precision-time protocol
- SNTP time synchronisation
- IRIG-B time synch, modulated or demodulated
- RSTP, or PRP and HSR as per IEC 62439-3
- SNMP v2c and v3
- USB front-port communication

P44 devices can be enhanced with an optional redundant Ethernet board. The redundancy is managed by the market's fastest recovery time protocols: IEC 62439-3 PRP and HSR allowing bumpless redundancy and RSTP, offering multi-vendor interoperability.

To help smooth transition from the existing protocol to IEC 61850, the P44 relay has been designed to provide Courier, -103 or DNP3 on the RS485 port, whilst providing IEC 61850 on the Ethernet port(s). This allows customers to future-proof their investment, getting ready for any future SCADA/DCS upgrade.

Second Rear Serial Port

An additional second rear Courier port can be ordered as an option, designed typically for engineering access by protection engineers/ operators when the main port is reserved for SCADA traffic. This port also offers the option of -103 or DNP 3 communications when IEC 61850 is the chosen first port protocol.

Ordering Options

	P44	x	x	x	x	x	x	#	#	**	#	#	Descriptions
Base Unit	P44												Base Unit
Distance and Autoreclose / Check Synchronising		3											Single Breaker
		6											Breaker and a Half or Dual Breaker Appplication
Nominal Auxiliary Supply Voltage			7										24-54 Vdc
			8										48-125 Vdc (40-100 Vac)
			9										110-250 Vdc (100-240 Vac)
CT and VT Ratings				1									In = 1A/5A ; Vn = 100-120Vac
				C									IEC 61850-9-2LE Sampled Analogue Values Ethernet - process bus model
Hardware Options					1								Standard - 1 x RS485 rear serial communications port provided with all ordering options (Courier, -103, DNP3 ready)
					2								With additional IRIG-B (Modulated)
					4								With additional IRIG-B (Modulated) & Serial Fibre Optic comms
					C								With additional IRIG-B (Un-modulated)
					E								With 2nd Courier protocol Rear Port
					F								With 2nd Courier protocol Rear Port + IRIG-B modulated
					R								Redundant Ethernet PRP/HSR/RSTP/Failover: 2 multi-mode fibre ports + Modulated/ Un-Modulated IRIG-B
					S								Redundant Ethernet PRP/HSR/RSTP/Failover: 2 copper ports RJ45 + Modulated/Un-Modulated IRIG-B
					T								Single and Redundant Ethernet Failover: 1 copper port RJ45 + 1 multi-mode fibre port + Modulated/Un-Modulated IRIG-B
Input / Output Options						A							8 inputs, 7 outputs (40TE, 60TE)
						B							8 inputs, 8 outputs (40TE, 60TE)
						C							8 inputs, 14 outputs (60TE)
						E							12 inputs, 12 outputs (60TE)
						G							16 inputs, 14 outputs (60TE)
						H							16 inputs, 16 outputs (60TE)
						J							16 inputs, 16 outputs + 4 High-Speed High-Break (60TE, 80TE)
						K							16 inputs, 21 outputs (60TE, 80TE)
						L							16 inputs, 24 outputs (60TE, 80TE)
						T							24 inputs, 16 outputs + 8 High-Speed High-Break (80TE)
						V							24 inputs, 32 outputs (80TE)
						Y							28 inputs, 43 outputs (P443 only - 80TE)
						2							32 inputs, 32 outputs (P443 only - 80TE)
						4							40 inputs, 24 outputs (P443 only - 80TE)
InterMiCOM^{64} Channel Options							A						Ch1=850nm multi-mode, Ch2=850nm multi-mode
							B						Ch1=1300nm single-mode, Ch2=not fitted (2 Terminal only)
							C						Ch1=1300nm single-mode, Ch2=1300nm single-mode
							D						Ch1=1300nm multi-mode, Ch2=not fitted (2 Terminal only)
							E						Ch1=1300nm multi-mode, Ch2=1300nm multi-mode
							F						Ch1=1550nm single-mode, Ch2=not fitted (2 Terminal only)
							G						Ch1=1550nm single-mode, Ch2=1550nm single-mode
							H						Ch1=850nm multi-mode, Ch2=1300nm single-mode
							J						Ch1=850nm multi-mode, Ch2=1300nm multi-mode
							K						Ch1=850nm multi-mode, Ch2=1550nm single-mode
							X						Without InterMiCOM^{64} Channels
Case Size and Mounting								S					80TE Case - Flush/Panel Mounting with Harsh Env. Coating, with USB Port and 10 Function Keys
								T					80TE Case - 19" Rack Mounting with Harsh Env. Coating, with USB Port and 10 Function Keys
								U					40TE Case - Flush/Panel Mounting with Harsh Env. Coating, with USB Port, without Function Keys
								V					60TE Case - Flush/Panel Mounting with Harsh Env. Coating, with USB Port and 10 Function Keys
Product Features									A				Subtransmission/Distribution Distance Protection, 3 Pole Tripping Only
									B				Subcycle Transmission Distance
Software Version										**			
Customer-Specific Additions											0		Standard version
											A		Customer-specific configuration/options
Hardware Version												Q	5th Generation Hardware, Graphical Colour HMI with High Performance Processing

Asset Life Extension

In addition to new-build, GE's 5th generation MiCOM relays can be used to refurbish time-served protection schemes. As the P44 is pin-pin compatible with forerunner P441, P442, P443, P444, P445 and P446 relays from Alstom, AREVA and GE, they can be interchanged in minutes for an easy upgrade. This dramatically reduces the retrofit time and cost.

Environmental Responsibility

The Relays are manufactured in a lead-free soldering process using lead-free components. Power dissipation is low, for smaller station batteries and to reduce the global warming potential (GWP) during the installed life.

GE-branded MiCOM P40 relays have no resident battery, to ease airfreight logistics and dispense with a maintenance item.

Cybersecurity

The sophistication of protection schemes, coupled with the advancement of technology, increasingly leads to devices and substations being networked. This introduces a potential security risk making the grid vulnerable to cyber-attack. To secure communication within such environments, MiCOM Agile P44 offers NERC®-compliant cyber security.

All of GE's MiCOM range is manufactured in ISO 27001 certified factories.

Quality Built-In (QBi)

Parts stress analysis in R&D, rigorous component supplier selection, and a shipping carton compliant with ISTA protection requirements all are examples of best-practice to maximise long-life reliability. All circuit boards have harsh environmental coating, to resist moisture, salt, corrosive atmosphere and industrial ambient pollution – as standard. The relay's case offers full encapsulation, with no ventilation holes for dust ingress.

Circuit board production uses in-circuit tests, boundary scanning, built-in self-test, automated optical inspection, and X-ray scanning to achieve maximum test coverage.

In addition to the standard -25°C to +55°C operating temperatures claim as per IEC 60255-6, the P40 range has proven withstand capability at extremes of temperature as per IEC 60068-2. These onerous tests were passed at -40°C and +85°C for 96 continuous hours in each case.

All MiCOM models offer power-up diagnostics and continuous self-monitoring for high availability.

Case Parameters

CASE TYPES	40 TE / 60 TE / 80 TE
Weight (40TE case)	7 kg - 8 kg*
Weight (60TE case)	9 kg - 12 kg*
Weight (80TE case)	13 kg - 16 kg*
Dimensions in (40TE case)	W: 206.0 mm H: 177.0 mm D: 243.1 mm
Dimensions in (60TE case)	W: 309.6 mm H: 177.0 mm D: 243.1 mm
Dimensions in (80TE case)	W: 413.2 mm H: 177.0 mm D: 243.1 mm
Mounting	Panel, rack or retrofit

** Depending on chosen options*

GE'S MICOM TRACK RECORD	
400 000	MiCOM P40 relays shipped from GE's plants
75 000	P44x line and cable distance shipped
160 000	Feeder manager and line terminal relays shipped

GE

Worldwide Contact Center

Web: www.GEGridSolutions.com/contact
Email: contact.center@ge.com
Phone: +44 (0) 1785 250 070

GEGridSolutions.com

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